

MSF Topical Module # 4

Braking

Topical Module # 4 - Braking

Topic: Braking

Recommended Time: 45 minutes for specific objectives 1-4, an additional 30 to 45 minutes for objectives 5 & 6.

Rationale: Improper braking is a leading cause of single motorcycle crashes. Improper/poor braking is a leading cause of the rider's choice of this crash avoidance technique NOT being successful.

General Goal: Upon completion of this module, riders understand that total braking distance is made up of components, will have an understanding of proper straight line braking techniques, will know that motorcycles are equipped with different braking systems, understand some general motorcycle characteristics that affect braking, and will have a means to measure their own performance.

Specific Objectives - Basic:

Upon completion of this module, each rider will be able to:

1. Describe the three components of total stopping distance
2. Describe the steps involved in executing a proper straight line quick stop

Specific Objectives - Beyond Basic

3. Describe the three (3) common braking systems and identify the system on his/her motorcycle
4. Describe characteristics related to his/her motorcycle that affect stopping distance

Specific Objectives - Advanced

5. Use the "coefficient of friction" formula to calculate braking distance using 3 different "f" values.
6. Describe the steps in calculating a personal "proficiency" level from several practice stops.

Materials and Items Needed:

- Common materials and items listed in the Topical Module Facilitators Guide
- MSF Basic *RiderCourse* Video segment on Advanced Braking
- Handout - Braking Basics
- Handout - Systems and Characteristics
- Handout - Calculating Braking Performance

Related Terms: impending skid, skid, lock-up, pressure, alignment, perception distance, reaction distance, braking distance, center of gravity, wheelbase, modulation,

Learning Activity Action Steps:

Each of the three handouts included with this Topical Module relates to the three groups of specific objectives. All six objectives could be addressed in a single session or the objectives could be addressed in 2 or 3 sessions.

Objectives 1 & 2

1. Conduct introductions and state the general goal of the session
2. Divide the large group in appropriate smaller groups of 3-6 participants each group

3. Show MSF video section on advanced braking (optional)
4. Distribute the Handout - "Braking - The Basics" and assign 1/2 of the small groups to read and be prepared to report on the "Three Components of Total Stopping Distance" and the other 1/2 to read and report on "Straight-Line Braking Key Points." Note: an alternative would be to brainstorm and chart this information and use the handout summary.
5. Use "student centered" questions during discussion

Objectives 3 & 4

6. Ask participants to report on the types of braking system on their motorcycle or about systems they are aware of. Use caution to ensure correct information is shared.
7. Ask participants to report regarding their knowledge about "Truths" about braking. You will need to provide an introduction to what you mean by "truths." Using a series of either/or questions will get participants thinking along the intended path. Examples are:
 - What results in shorter stopping distances - sticky tires or hard compound tires?
 - Lower center of gravity or high center of gravity?
 - Long wheel base or short?
8. Pass out the handout - "Systems and "Truths"
9. Review the information using learner centered questions

Objectives 5 & 6

1. Pass out the Handout "Calculating Braking Performance" and lead participants through the series of questions providing time for small group discussion and calculation.
2. Provide time for feedback, discussion and questions with each numbered question on the handout

Evaluation:

If conducted in separate sessions use the evaluation and feedback forms at the end of each session.

Alternative Learning Activity

Using the "jigsaw" group learning method, as described below, would be a viable learning activity especially with experienced riders. The "jigsaw" will require having 3 to 5 resource articles (or book sections, chapters, etc.). Using the four sections from the handouts "Braking - The Basics" and "Systems and Truths" is an option although these are a bit short. Another option is to use sections from other resources, for example, books such as *Total Control* by Parks or pages 76 to 90 from David Hough's *Proficient Motorcycling*.

Jigsaw: This is a learning method where participants read, analyze, discuss and teach to each other the important points from selected printed material (short articles). It is a very engaging method that works very well with groups of 15 or more. It takes careful pre-planning by the facilitator but little more than directing and monitoring the process during the session. Here's how it works with a group of 25 and 5 topic related articles (group distribution will need to be adjusted with different size groups and different number of articles.)

- First, have participants seated at table groups of 5 (5 tables of 5 in this case). This is their "home group," the group they sat down with (or were directed to) when they arrived and participated in introductions, etc.

- Second, have participants at each table number off 1-5, so that each table has a person # 1, a person # 2, etc. Participants need to remember where and whom they were sitting with at their "home table" as they will return to this group.
- Next, form new groups with the same numbered person from each table going to the new groups so all the # 1's are at one table, all the # 2's a second table and so on. These new groups are the "expert groups."
- Now, pass out to each "expert group" a different article or information source related to the Topical Module topic. Articles of 1-3 pages in length work well. If you have longer articles break them into sections. Either way, each expert group needs different material. You will need to have prepared 5 copies each of 5 separate articles (color-coding works wonders here).
- Tell the participants they are now in their "expert groups" at which they will become experts in the information they have been given. Your role now is to monitor the time as follows:
 - 5 minutes (adjust for length of article) to individually read the material
 - 7 minutes to talk about the important points with other members of their "expert group"
 - 3 minutes to individually think and plan how you will teach this information to the members of their "home group." Tell them their lesson should take no more than 3 minutes.

Carefully monitor the time and at the end of the 15 minutes direct individuals to return to their home groups.

- Have participants in numbered order begin the "teaching rounds". Person # 1 takes 3 minutes to teach his/her information to the other members of the home group, and then person # 2 takes 3 minutes to teach his/her information, etc. Monitor the time.

The "jigsaw" process allows a great deal of material to be introduced in an engaging, learner-centered manner in just 30 minutes. Adding some time for opening, closing and transitions will make the total Topical Module session 45 minutes to one hour.

Braking - The Basics

Three Components of Total Stopping Distance:

The total distance it takes to stop your motorcycle is made up of three components. The first is *perception distance*. Perception distance is the distance traveled from the time something is present until you see it. Some experts divide perception distance into sub components also but for our needs it is sufficient for us to understand that it takes time for our eyes and brain to work and while our eyes and brain are doing their jobs our motorcycle is traveling down the roadway. Age and impairments increase perception distance. The second distance is *reaction distance*. This is the distance our motorcycle travels from the time our brain tells us our eyes have seen something to the time we begin our braking. Natural ability, age, physical condition and impairments affect reaction time and therefore distance traveled. The third distance is *braking distance*. Braking distance is the distance traveled from the time the brakes have been applied to fully stopped. The condition of the brake components, the type of motorcycle and the type of braking system can each impact braking distance but the single biggest factor is rider skill. The braking distance difference between an expert or very proficient rider and someone who lacks proper braking skill can only be described by words such as huge, dramatic or astounding.

Straight-Line Braking Key Points

Stopping your motorcycle in the shortest possible distance is one of the most important skills to possess. Practice in a safe area as often as possible to keep the technique fresh. Keys to stopping quickly include:

- Apply both brakes fully without locking either wheel. The target is impending skid. A skidding wheel will increase stopping distance over a wheel at impending skid.
- Simultaneously squeeze the front brake and press the rear brake pedal
- Use firm to firmer pressure on the front brake
- Use light to lighter pressure on the rear brake
- Keep you body centered and look well ahead - head and eyes up
- If a front-tire skid occurs, immediately release the front brake pressure to allow the wheel to resume rolling, and then reapply
- If the rear wheel locks on a surface where traction is good and the rear wheel is out of alignment with the direction of travel, it is best to keep the wheel locked and steer in the intended direction of travel.
- When the rear wheel skids, the ability to turn is lost.
- If the rear wheel locks and the rear wheel is nearly aligned with the front wheel, it is possible to regain control by releasing some rear brake pressure and allowing the wheel to resume rolling.

Systems and "Truths"

Braking Systems:

Motorcycles have four common braking systems.

- **Independent system:** Most motorcycles have a system where the operation of the front and rear brakes are independent from each other with a lever for application of the front brake and a pedal for application of the rear brake.
- **Integrated Brakes:** This is a system where application of the rear brake will cause some application of the front brake. These systems were developed to assist riders who fail to use or under use the front brake. This system may affect low-speed maneuvers where the rider wishes to use rear brake only.
- **Linked Brakes:** Similar to the integrated system except application of either front brake or rear brake will cause some pressure to be applied to the other brake.
- **Anti-Lock Brakes:** These systems are designed to prevent or minimize skidding in a maximum-braking straight-line stop. They are an important safety feature, which help prevent crashes caused by the riders unintentional locking of the brakes. Some experts on selected motorcycles can stop in shorter distances without the anti-lock system, but for the average rider the anti-lock systems are extremely valuable in emergency situations.

Some "Truths" about Braking:

This information is taken from "Total Control: High Performance Street Riding Techniques" by Lee Parks, chapter 11, Braking. This chapter is an excellent resource.

1. The longer the wheelbase, the shorter the braking distance.
1. The lower the center of gravity, or CG, the shorter the braking distance.
2. The stickier the tires, the shorter the braking distance.
3. The more efficient the braking system, the shorter the braking distance.
4. Using both brakes will result in the shortest stopping distance.
5. Modern sport bikes and race bikes are all limited by their wheelbase or center of gravity.

Calculating Braking Performance

1. Total stopping distance is made up of three (3) components - perception distance, reaction distance and braking distance. Discuss these three components. What exactly is happening during the time that passes for each component? What impact or affects the time for each component?
2. Consider the two components reaction distance (time) and braking distance (skill/performance). Of these two, which is most important in total stopping? Can skill in one area overcome poor performance in the other (within the reasonable limits of most riders)?
3. If normal (expected) reaction time is .5 second, how far does a rider traveling 60 MPH travel in .5 second (someone in your group knows 60MPH = X feet per second). OK, so how many feet does the rider with a reaction time of .4 second save vs. the normal .5 second? And how many more feet does the person with a .6 second reaction time travel? Be prepared to show or describe by comparison to some readily known object how many feet travel difference there is at 60 MPH between a ".4 second reactor" and a ">.6 second reactor."
4. Accident investigators (and others) use the terms "coefficient of friction" or "drag factor" to describe the "grip or braking performance" of vehicles. This is referred to as an "f" value and was established as a decimal portion of 1. The accepted "f" value for an automobile, with 4-wheel lock on dry asphalt, is .75. A higher "f" value (eg. .85) means shorter braking distance. A lower value (eg. .50) means a longer braking distance. A car in a four-wheel skid on wet asphalt would have a lower "f" value than the standard .75. Discuss this as related to motorcycle braking. What contributes to the "f" value - braking system, tire compound, tire pressure, rider skill, both brakes, rear only, etc.?
5. So, if we can put the reaction time = distance traveled into a formula and the "f" value representing braking performance into a formula, we can figure out the stopping distance for these two components (total stopping distance includes perception distance) for any given speed.

Here are the formulas:

$$\text{Reaction Distance} = \text{Speed} \times 1.47 \times \text{time}$$

$$\text{Stopping Distance} = \frac{\text{Speed (squared)}}{30 f}$$

Using the formulas calculate the following: Two riders are traveling at 60 MPH and they both perceive the hazard at the same time. One rider is a slow reactor (.6 second) and uses the rear brake only producing a drag factor/coefficient of friction or "f" value of .35. The other rider is a quick reactor (.4 second) and used both front and rear brakes nearly as well as an expert producing a "f" value of .90. Be prepared to describe in feet or by story or example the difference in total stopping distance (not including perception distance).

6. Describe how you could calculate an "f" value for your braking performance? Expert riders can

generate "f" values of 1.0 to 1.2. What might be an "f" value for a very proficient street rider? If your initial "f" value from your practice stops is not in a proficient range, what will you need to do to improve your barking performance? Describe the specific action you will need to take.